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PRE- AND POST-FUMIGATION SOIL ASSAY FOR PLANT PATHOGENS, LUCKY PEAK FOREST NURSERY, IDAHO

By
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INTRODUCTION

Over the past several years Forest Pest Management has provided assistance in identifying pests causing conifer seedling mortality at the USDA Forest Service Lucky Peak Forest Nursery located near Boise, Idaho. Species of Fusarium have frequently been identified associated with mortality of Douglas-fir, spruce, and true fir. Previous evaluations have been conducted to estimate soil population levels of Fusarium prior to and immediately following soil fumigation to determine fumigant effectiveness in the upper 15.24 cm of soil. The purpose of this evaluation was to identify soil-borne plant pathogens, estimate their population levels within the upper 0.0-to-15.24 and 15.24-to-30.48 cm of soil prior to and following fumigation, and to determine pathogenicity of isolated species.

MATERIALS AND METHODS

Soil Fumigation.-- Fields 1, 6, and 7 of the Lucky Peak Forest Nursery were fumigated in September, 1984, with a mixture of 67% methyl bromide and 33% chloropicrin at a rate of 392.3 kg/ha. Full field plastic tarps were installed during fumigation and were retained for several days thereafter.

Soil Sampling.-- Lucky Peak Forest Nursery personnel extracted pre-fumigation soil cores on August 30th and post-fumigation cores on September 12th, 1984, immediately following tarp removal. Five soil cores, 2.54 cm in diameter, were

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extracted from each of 11 sample points, one point per field compartment, as follows:

Field 1 -- Compartments 3, 5, 7, 17, and 30
Field 6 -- Compartments 2, 4, 6, and 13
Field 7 -- Compartments 2 and 7.

Soil samples from 0.0- to 15.24-cm and 15.24- to 30.48-cm depths from each sample point were maintained separately in coolers at the nursery until transported to the Boise Field Office of Forest Pest Management at the end of September.

Isolation Methods.-- After allowing samples to air-dry overnight at room temperature (20-22 C), 0.1 g of soil was extracted from each sample, added to 40 ml of 0.5% cooled molten water agar, and thoroughly stirred. While in suspension 1 ml was drawn by sterile syringe and dispensed onto petri plates containing malt extract agar and petri plates containing potato dextrose agar. Inoculated plates were incubated at room temperature and examined within one week for presence of fungal colonies.

RESULTS

Pathogens.-- Identification, to the genus level, of fungal colonies was possible one week following plate inoculations. Several primarily saprophytic fungi including species of Trichoderma, Penicillium, Alternaria, and Rhizopus were noted, but their populations were not evaluated. Probable seedling pathogens recovered were Fusarium spp. Cultures of the different Fusarium spp. were sent to Dr. John Woo at the Intermountain Forest and Range Experiment Station in Moscow, Idaho, for species identification and pathogenicity testing. Dr. Woo identified two different species of Fusarium: F. oxysporium (Schl.) em Snyd. & Hans. and F. roseum (Lk.) em Snyd. & Hans. Pathogenicity tests indicated both species were highly pathogenic on Douglas-fir seedlings. Pathogenicity tests on other tree species were not conducted.

Pathogen Populations.-- Once identification was possible, numbers of Fusarium colonies were counted. Pre- and post-fumigation levels of Fusarium spp. isolated at each sample point are presented in Table 1. Population levels are given as propagules per gram of air-dried soil. A propagule is any fungal structure capable of growing, given an appropriate food base and favorable environmental conditions. Colony counts for both media were averaged for each sample point as both media yielded similar numbers of colonies.

Fumigation was 100% effective in eliminating Fusarium from the upper 15.24 cm of soil immediately following fumigation. However, fumigation eliminated only 84% of the Fusarium propagules at depths of 15.24-to-30.48 cm. Overall, fumigation was 92% effective in the upper 30.48 cm of soil. Fusarium population levels at these sample points were not determined for any other post-fumigation time period other than immediately following tarp removal.

DISCUSSION AND RECOMMENDATIONS

This and a previous evaluation (Marshall 1983)[2/] show that fumigation with 67%

2/ Marshall, J. P. 1983. Effectiveness of methyl bromide/chloropicrin fumigation in reducing Fusarium populations in two major soil types at the USDA Forest Service Lucky Peak Forest Nursery. USDA Forest Service, Intermountain Region, Forest Pest Management Rpt. No. 83-6, 9pp.

Table 1. Population levels of Fusarium spp. prior to and immediately following fumigation with 67% methyl bromide and 33% chloropicrin at Lucky Peak Forest Nursery. Population levels are given as propagules per gram (ppg) of air-dried soil.

Sample Point	Soil depth of 0.0-15.24 cm		Soil depth of 15.24-30.48 cm		Average	
	Before	After	Before	After	Before	After
	----- Average Fusarium ppg -----					
Field 1:						
Comp. 3	0	0	0	0	0	0
Comp. 5	200	0	0	0	100	0
Comp. 7	0	0	0	0	0	0
Comp. 17	200	0	0	0	100	0
Comp. 30	0	0	0	0	0	0
Field 6:						
Comp. 2	0	0	0	200	0	100
Comp. 4	0	0	2400	200	1200	100
Comp. 6	800	0	800	0	800	0
Comp. 13	1400	0	0	0	700	0
Field 7:						
Comp. 2	600	0	1200	400	900	200
Comp. 7	1600	0	600	0	1100	0
Average for all plots:	436	0	455	73	445	36
% Reduction:		100%		84%		92%

methyl bromide and 33% chloropicrin is effective in reducing Fusarium spp. levels in the upper 30.48 cm of soil at Lucky Peak Forest Nursery. Effective fumigation provides germinating seedlings a chance to become established before residual populations of soil-borne plant pathogens at lower soil depths or wind-blown spores of such pathogens from outside the fumigated beds invade the upper soil layers.

Care should be taken to ensure maximum penetration of fumigant in certain areas of normally "heavy" soil. Soils in these areas should not be saturated with water prior to fumigant application as such conditions will not allow effective penetration of the fumigant. Pathogen populations in such poorly fumigated areas can quickly build to threatening levels at shallow soil depths and affect seedlings at an early age.